INEEL Oversight
Idaho's eyes on the INEEL

2002 Environmental Surveillance Report

A compilation and explanation of data collected by the INEEL Oversight Program during 2002

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Abstract

After completing an independent assessment of the environmental conditions in the vicinity of the Idaho National Engineering and Environmental Laboratory (INEEL) during 2002, the state of Idaho's INEEL Oversight Program (INEEL OP) concluded:

- No offsite environmental impacts from INEEL operations were evident as a result of particulate air sampling.
- Tritium was detected in atmospheric moisture samples from two onsite-monitoring locations. However, these concentrations are significantly below risk-based threshold levels.
- No offsite environmental impacts from INEEL operations were evident as a result of milk or soil sampling.
- At monitoring locations on and near the INEEL, gamma radiation measurements remained within background levels.
- Of the contaminants that the INEEL OP monitors in groundwater, only tritium and chromium were above background levels near the southern boundary of the INEEL. However, concentrations were less than the EPA drinking water standards.
- Gross beta and strontium-90 concentrations detected in groundwater on the INEEL did exceed EPA drinking water standards; however, these detections were not from wells used for drinking water.
- The wastewater and groundwater verification program for onsite locations shows that most of the INEEL OP data were comparable with data from the primary contractor and the Naval Reactors Facility.
- Analytical data reported by surveillance programs of the INEEL OP and the U.S. Department of Energy (DOE) generally agree.

The state of Idaho will continue monitoring conditions at and near the INEEL to assess potential impacts on public health and the environment.

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Introduction

To determine the impacts that INEEL activities may have on public health and the environment, the state of Idaho maintains the INEEL Oversight Program (INEEL OP). The INEEL OP provides independent assessments of contaminants resulting from DOE activities at the site. It monitors the condition of air, water, external radiation, and soil within the boundaries of the INEEL and air, water, external radiation, soil, and milk at offsite locations. Water monitoring efforts include groundwater, surface water, and effluent sample collection. The INEEL OP reports data from these environmental surveillance efforts quarterly and annually, and reviews data collected from previous years to identify any discernible trends. The INEEL OP's independent findings are used to compare with and supplement data reported by DOE environmental surveillance programs (ESP).

The DOE, likewise, maintains a surveillance network to assess any impacts that the INEEL may have on public health and the environment. Several organizations were responsible for carrying out the DOE's environmental surveillance program at the INEEL during 2002. As the INEEL prime contractor with DOE, Bechtel BWXT Idaho, LLC (BBWI) measured external gamma radiation and analyzed environmental samples of air, drinking water, and soil; made *in-situ* soil measurements within the boundaries of the INEEL; and performed limited sampling offsite.

Also contracted by DOE, the S.M. Stoller Corporation's Environmental Surveillance Education and Research Program (ESER) provided environmental surveillance outside the boundaries of the INEEL, and to a limited extent, within the boundaries. Environmental measurements made by ESER included external radiation, analysis of airborne particulate matter, water (drinking and surface), animal tissue, foodstuffs (milk, potatoes, wheat, and lettuce), and soil. Argonne National Laboratory-West (ANL-W) performed the monitoring at that facility, and Bechtel Bettis conducted monitoring at the Naval Reactors Facility (NRF). Groundwater surveillance was

conducted primarily by the United States Geological Survey (USGS), which samples aquifer wells on the INEEL and throughout the Eastern Snake River Plain.

The INEEL OP does not attempt to duplicate the DOE's extensive surveillance network. Instead, select locations are sampled to provide a representative overview of the environment on and around the INEEL. Comparison with DOE's data is accomplished by analyzing samples of air, soil, milk, and water collected at the same place and approximate time. In those instances where the INEEL OP collects samples at different locations and/or with different instruments, or for different analyses, the subsequent results supplement data collected by the other organizations.

The following sections briefly describe the INEEL OP's environmental surveillance programs, summarize the 2002 surveillance results, discuss identified trends, and present comparisons of the data reported by the INEEL OP and various DOE monitoring programs.

Air Monitoring

Air Monitoring - Particulate Matter and Gaseous Radionuclides

Monitoring Network and Instrumentation

In 2002, the INEEL OP operated ten air-monitoring stations strategically located on and around the INEEL. Data for samples collected at an air monitoring station in Fort Hall operated by the Shoshone-Bannock Tribes are also included in this report. At the ten INEEL OP operated locations, high-volume total suspended particulate (TSP) samplers operate continuously collecting particulate matter. The INEEL OP began using high-volume TSP samplers in 2001 as the primary particulate air samplers after the completion of a two-year investigation comparing these samplers to the PM_{10} samplers historically used by the INEEL OP.

To supplement the particulate air sampling, three intermediate-flow PM_{10} samplers are operated continuously collecting particulate matter with an aerodynamic diameter less than 10 micrometers at three of the ten INEEL OP operated locations mentioned above. A charcoal cartridge designed to adsorb gaseous radioiodine is placed in series following the particulate filter within each PM_{10} sampler.

Sample Collection Methods and Analysis

Sample collection and analysis followed regular schedules and written sampling and analysis plans as well as procedures. On a weekly basis, INEEL OP staff collected the filters and charcoal cartridges from the PM_{10} and filters from the TSP samplers. Filters were analyzed with gas-flow proportional counting to measure gross alpha and gross beta radioactivity. Charcoal cartridges were analyzed with gamma spectroscopy to detect gamma-emitting radionuclides, with specific reporting of iodine-131. On a quarterly basis, the filters were composited by location and analyzed with gamma spectroscopy for man-made, gamma-emitting radionuclides, with specific reporting of ruthenium/rhodium-106, antimony-125, cesium-134, and cesium-137. TSP samples

from all four quarters of 2002 were then composited by location and analyzed radiochemically for strontium-90, plutonium-238, plutonium-239/240, and americium-241.

Results, Trends, and Interprogram Comparisons

Air monitoring results for 2002 are summarized below, as are any trends identified through the evaluation of air monitoring data collected by the INEEL OP since 1994. In addition, these results are compared to those reported by DOE's ESP at four air monitoring stations that are co-located with those operated by INEEL OP.

Gross Alpha and Gross Beta Radioactivity Results

Particulate air samples collected during 2002 showed concentrations of airborne radioactivity at typical historical background values. Elevated gross alpha and gross beta concentrations observed are likely due to elevated concentrations of longer-lived radon progeny trapped in the lower atmosphere during periods associated with temperature inversions. These conclusions are supported by gamma spectroscopy and radiochemical analyses results as discussed below.

Trend analysis of gross alpha and gross beta radioactivity data collected by the INEEL OP since 1994 shows that both measurements fluctuate following natural seasonal patterns at each of the sample sites.

Direct comparisons of gross alpha and beta screening measurements with other programs were difficult to quantify due to variations in air-sampling methodologies between these programs. However no significant disagreements were noted.

Iodine-131 Results

No iodine-131 was detected on charcoal cartridges collected in 2002, and none has been detected since the INEEL OP began air sampling in 1994. Similarly, the DOE monitoring programs did not report any iodine-131 detections during the 2002 sampling period.

Gamma Emitting Radionuclide Results

Gamma spectroscopy performed on the 2002 quarterly composited particulate filters did not detect the presence of man-made, gamma-emitting radionuclides.

Beryllium-7, a naturally occurring cosmogenic radionuclide, was reported above the minimum detectable concentration of the laboratory. The levels of beryllium-7 concentrations were consistent for each sampling period at onsite, boundary, and distant locations.

Radiochemical Results

Transuranic radionuclides were not detected on annual filter composites using radiochemical analysis techniques.

Strontium-90 was measured at several monitoring locations, but the concentrations observed were well below levels that would pose a risk to human health.

Air Monitoring - Atmospheric Moisture and Precipitation

Monitoring Network and Instrumentation

In 2002, the INEEL OP operated 11 atmospheric moisture sampling stations strategically located on and around the INEEL. At all 11 locations, air samplers containing cartridges filled with molecular sieve beads (a desiccant) were co-located with the TSP air monitoring stations. The beads adsorb and retain moisture from air drawn through the cartridges by a pump.

Additionally, six of the eleven atmospheric moisture-sampling stations are equipped to collect precipitation.

Sample Collection Methods and Analysis

The molecular sieve beads were collected and processed at the end of each quarter, or when the beads had almost reached saturation, whichever occurred first. Moisture removed from the beads was analyzed for tritium, a radioactive isotope of hydrogen. Precipitation was collected quarterly or sooner if the container became full, and was analyzed for tritium and gamma-emitting radionuclides.

Results, Trends, and Interprogram Comparisons

Tritium

Tritium was detected in atmospheric moisture samples at two onsite monitoring locations, the Experimental Field Station and Van Buren. The tritium concentrations observed onsite are significantly below levels that would pose a risk to human health.

Each program follows slightly different protocols for monitoring extremely low concentrations of tritium in the atmosphere, including the use of different adsorbents, different sampling periods, and other interprogram variables that complicate direct comparisons between programs. The INEEL OP and BBWI atmospheric tritium monitoring results demonstrated very good agreement. Variations between INEEL OP and ESER atmospheric monitoring results demonstrated poor agreement due to differences in adsorbent media, analytical techniques, and sampling schedules used by individual monitoring programs. While there are differences in results, the measurements

observed were well below levels that would pose a risk to human health. No tritium was observed in INEEL OP precipitation samples collected in 2002.

Gamma-Emitting Radionuclide Results

Precipitation samples collected during 2002 did not show measurable concentrations of man-made, gamma-emitting radionuclides, as has been the case since 1994, when the INEEL OP began collecting precipitation.

Terrestrial Monitoring

Monitoring Network and Instrumentation

Milk was collected monthly at four processing plants in southeastern Idaho and the Magic Valley. These plants processed milk from dairies located both near and distant from the INEEL boundary.

Soil samples were collected from seven locations on the INEEL as well as at eight boundary and distant locations. *In-situ* soil measurements were also made at 54 locations on the INEEL as well as at boundary and distant locations.

Sample Collection Methods and Analysis

Milk samples were collected from fresh dairy shipments and analyzed using standard gamma spectroscopic methods. Iodine-131 and naturally occurring potassium-40 activity results are always reported, while other gamma-emitters are reported only if detection limits are exceeded.

Soil samples were collected from undisturbed locations near radiation monitoring stations at two depths, 0-5 cm and 5-10 cm, and analyzed with gamma spectroscopy. In addition, the concentrations of radionuclides in soil were measured *in-situ* (i.e., directly in the field) reducing the number of areas of soil that are disturbed by physically collecting a sample. Radionuclide concentrations measured *in-situ* are determined using an intrinsic, high-purity germanium detector assuming the distribution of radionuclides in the soil was homogenous throughout a soil depth of 0 to 5 cm.

Results, Trends, and Interprogram Comparisons

Naturally occurring potassium-40 was the only radionuclide detected in milk samples. Levels were consistent with concentrations measured by the INEEL OP in the past. The reported concentrations of iodine-131 have been less than the minimum detectable concentration since the inception of milk sampling in 1996. Likewise the ESER milk monitoring program, which collects from the same processing plants as well as some private dairies, did not detect iodine-131 over this same period.

INEEL OP conducted seven *in-situ soil* measurements with BBWI in 2002 for comparison purposes. Some differences were expected between gamma spectroscopic results due to analytical differences, but the cesium-137 concentrations reported by BBWI and INEEL OP correlated relatively well. During 2002, the INEEL OP collected ten soil samples with ESER. Results for cesium-137 concentrations demonstrated poor agreement, while the potassium-40 concentrations demonstrated relatively good agreement.

Water Monitoring

The INEEL OP water monitoring is divided into two programs distinguished by the primary purpose of the sampling; surveillance water monitoring and verification water monitoring. While both water sampling programs involve co-sampling with other INEEL monitoring programs, surveillance monitoring is designed to allow identification of trends in specific contaminants as well as INEEL impacts of overall groundwater quality. Samples are collected for the same analytes at all surveillance sites, unless gross radioactivity screening analyses indicate the presence of other INEEL contaminants. Verification monitoring collects samples for selected analytes based on permit, Record Of Decision, or investigation-derived requirements. Both sampling programs yield sample results that can be compared with that of the primary sampling programs.

Monitoring Network and Instrumentation

The INEEL OP monitors water quality at 78 locations: 28 groundwater and surface water sites on and around the INEEL, 5 drinking water sites and springs distant from the INEEL, and 45 groundwater sites and springs in the Magic Valley. INEEL OP also co-samples with the DOE's primary contractor, the monitoring group at ANL-W, and NRF at 33 locations on the INEEL.

Sample Collection Methods and Analysis

Water samples are collected and analyzed not only to detect contaminants known to have been disposed at INEEL facilities, but also to compare with and supplement INEEL data and provide information on general water quality. Water samples are collected following established procedures, and with methods comparable with those used by ANL-W, NRF, BBWI, USGS, and ESER. Samples collected for surveillance monitoring are analyzed for select trace metals, common ions, and nutrients that track constituents reported in wastes disposed to the aquifer beneath the INEEL. This same selection of nonradiological analytes also gives a picture of overall groundwater quality for the aquifer beneath the Eastern Snake River Plain. Gross radiological screening measures, gross alpha and gross beta radioactivity, gamma radioactivity, and tritium provide measures of background concentrations and INEEL waste disposal-related levels. Analytes for verification monitoring reflect regulation or agreement-required analytes based on historic waste disposal or contamination.

Results, Trends, and Interprogram Comparisons

Nonradiological Constituents

Calcium, chloride, magnesium, potassium, sodium, sulfate, total nitrogen and total phosphorus are known INEEL waste constituents that were detected above background levels in 2002 at some wells within known contamination plumes on the INEEL. However, none of the samples collected by the INEEL OP since 1994 exceeded the drinking water standards for these constituents.

Trace metals, barium, chromium, lead, manganese, and zinc were detected above background levels in samples collected within known groundwater contaminant plumes on the INEEL. Only chromium exceeded the maximum contaminant level (MCL) for drinking water, and only at one well that is not used for drinking water. Barium was detected above background at wells near the Idaho Nuclear Technology and Engineering Center (INTEC) and the Central Facilities Area (CFA). Chromium was above background levels in several wells on the INEEL due to historic wastewater disposal at the Test Reactor Area (TRA) and INTEC. Elevated levels of lead, manganese, and zinc may be attributable to well construction materials, existing natural concentrations in the environment, and INEEL activities. These findings are consistent with results reported by INEEL OP since 1994. During 2002, replicate samples for nonradiological constituent analysis were collected with the USGS at 26 groundwater and surface water locations on and near the INEEL, and at 17 locations in the Magic Valley. The INEEL OP and ESER co-sampled at three springs and two drinking water supply wells south of the INEEL and in the Magic Valley. INEEL OP and ESER sampled two additional locations, although not at the same date and time. Comparisons of nonradiological data reported by the INEEL OP and the USGS show excellent agreement for all replicate data.

The nonradiological results reported by the INEEL OP for the verification monitoring program were generally similar to the results reported by ANL-W, NRF, and the DOE's primary contractor at the INEEL. Replicate sample pairs for total phosphorus, aluminum, copper, nitrate + nitrite, sulfate, TKN, iron, zinc, trichloroethene, and total suspended solids failed the comparison criteria. Differences in results were generally attributed to sample heterogeneity and differences in analytical methods.

Radiological Constituents

Gross alpha screening measurements exceeded laboratory detection limits for samples collected at 23 locations during 2002. Gross alpha radioactivity measurements were well below the MCL for drinking water and within expected background levels.

Concentrations of gross beta radioactivity were detected above background in samples from all onsite wells except one. The highest concentrations were observed for two wells known to be impacted by INEEL wastewater. Radiochemical analyses of selected samples from these onsite wells indicate that strontium-90 is the primary source of the gross beta radioactivity. Although

strontium-90 exceeded the drinking water standard at one of these wells, the well is not used for drinking water.

Analyses were also conducted for gamma emitters and technetium-99. No gamma emitters were detected except for naturally occurring potassium-40 at six sites. Technetium-99, a fission product created in nuclear reactors, was detected in samples collected from four wells sampled on the INEEL.

Concentrations of tritium caused by historical waste-disposal practices were detected at levels near, but below, the drinking water standard at several INEEL wells. Overall, tritium concentrations appear to be decreasing within the identified plume at the INEEL. Elevated levels of tritium measured in wells at the Radioactive Waste Management Complex (RWMC) have remained fairly constant since INEEL OP began sampling. At offsite wells near the southern INEEL boundary, tritium has been detected at levels above background, but those levels are only about one percent of the drinking water standard.

The INEEL OP collected replicate samples in 2002 with the U.S. Geological Survey (USGS) on and near the INEEL, and south of the INEEL to the Snake River Canyon between Twin Falls and Hagerman. Replicate samples were also collected for the five locations where the INEEL OP co-samples with ESER in the Magic Valley. In addition, data for two additional locations where both INEEL OP and ESER collect samples were included in the comparisons. In general, the INEEL OP's radiological sample results showed good agreement with data reported by co-sampling organizations. Excellent agreement was noted for all nonradiological parameters. Although statistically significant differences were observed for gross alpha and gross beta radioactivity, these differences were relatively small compared to the concentrations observed. Data from co-sampled locations showing the greatest relative differences were strongly influenced by differences in analytical methods and sampling practices.

For the verification program, gross alpha, gross beta, and technetium-99 results did not meet the comparison criteria. The differences in the gross alpha and gross beta analyses are attributed to normal analytical variability or sample heterogeneity.

Environmental Radiation Monitoring

Monitoring Network and Instrumentation

In 2002, the INEEL OP maintained a network of 11 stations equipped with high-pressure ion chambers (HPICs), which continuously measure environmental penetrating radiation levels from natural cosmic and terrestrial sources, as well as from operations at the INEEL. Environmental radiation data collected at Fort Hall are also included. At each of the radiation monitoring stations, electret ion chambers (EICs) were also deployed to provide a cumulative total of radiation exposure at that location for the calendar quarter.

Measurement and Analysis

Penetrating radiation levels measured by the HPICs were compiled to provide daily, weekly, monthly, and quarterly average exposure rates. EICs were collected and processed quarterly.

Results, Trends, and Interprogram Comparisons

Cumulative radiation measurements from the HPICs were consistent with historical background levels measured by the INEEL OP. Because these instruments are not co-located with DOE-ID contractors, a comparison could not be made.

Penetrating radiation readings for the EICs were also consistent with historical background results. Although the results reported by the INEEL OP, BBWI, and ESER in 2002 fell within levels accepted as background, direct comparisons of the programs' results reflect interprogram variation due to different measurement schedules and monitoring techniques. Also, EICs used by INEEL OP are slightly more responsive to low-energy gamma and x-ray photons than the dosimeters used by other organizations and show slightly higher exposures from natural sources.